Space Weather Technical Forecast

Issued on Thursday, 20 June 2024 at 13:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares likely (R1-R2 radio blackouts), slight chance of X-flares (R3 blackouts). Chance of S1/Minor radiation storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has fallen to Low, with peak flare recorded a C5.9 at 19/0919 UTC. There are eight sunspot regions on the disc, with a small and simple new region appearing in the southwest. The largest region remains AR3712, continuing it's spreading trend, but without any major change in overall size, with delta regions having reformed in the trailing portion. AR3713 has continued growing, with a large delta region in one of its leading spots. AR3716 has also seen a slight growth, with a delta region remaining present in the intermediate portion. AR3719 and AR3720, close to the east limb, appear as smaller bipolar regions with the southernmost region showing a slight growing trend, now with established penumbra. The as yet unnumbered region in the northeast is simple, along with the small bipolar region, AR3718, close to centre disk.

No obviously Earth directed CMEs have been seen in the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, showed declining fast wind influence from CH45/+. Wind speeds fell from elevated, 550 km/s, to slightly elevated, 470 km/s. Density was below average throughout. Interplanetary Magnetic Field, Bt, was weak, below 6nT. The north-south component, Bz, varied weakly between +/-5nT. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity has been Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 reached moderate levels, peaking at 410 pfu at 19/1530 UTC. The 24-hour fluence was below Active on a rising trend, reaching 9.7e6 integrated pfu at 20/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: M-flares are likely, with a slight chance of isolated X-class flares, most likely from AR3712, AR3713 or AR3716.

Solar Wind / Geomagnetic Activity: No obviously Earth directed CMEs have been seen in coronagraph imagery, although given the number of recent CMEs there is some uncertainty. Wind speeds have been elevated due to CH45/+, and are expected to continue to slowly decline over the next couple of days. A further enhancement from the large coronal hole CH46/- in the northern disc is possible, although confidence is currently low in the timing and strength of this feature. Wind speeds potentially returning to elevated, by the end of Day 2 or into Day 3 (21-22 Jun). Any geomagnetic response is expected to be limited at this time of year.

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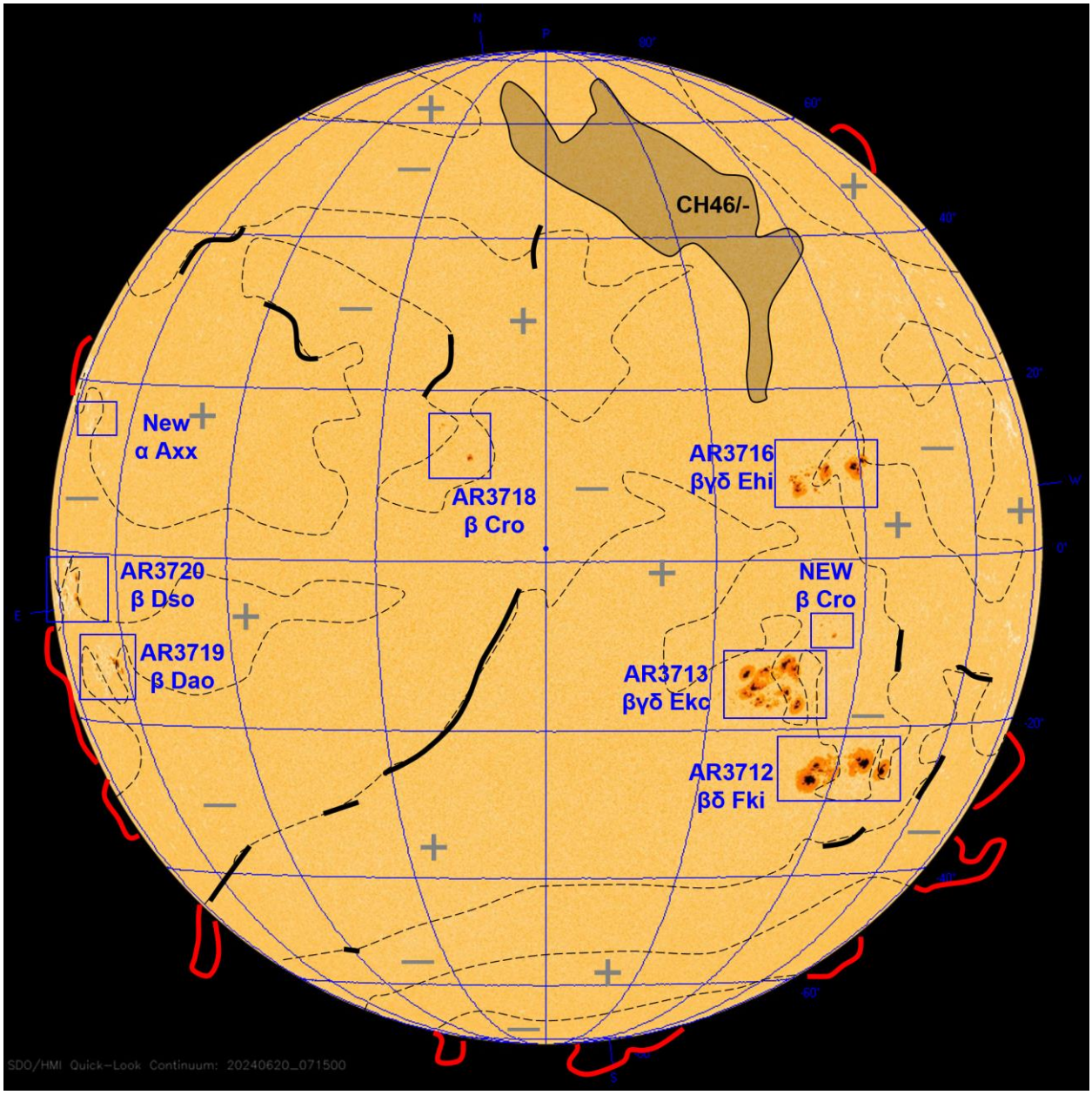
Met Office Space Weather Technical Forecast

Mainly Quiet to Unsettled geomagnetic activity is expected. There is a chance of isolated Active intervals Day 2 into Day 3, should we see any HSS enhancement from CH46.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels, but with a chance of rising to S1 levels, should any notable flares occur from one of the three spots in the western hemisphere. High energy electron flux is forecast to be at background to moderate levels. The associated 24-hour fluence is expected to remain below the Active threshold, but with a slight rising trend.

Figure 1. Solar Analysis Valid 20/0715 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

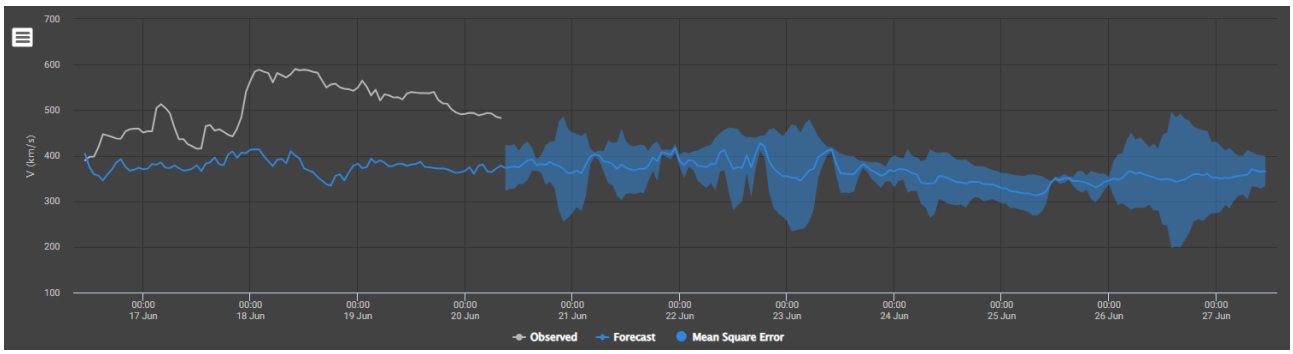
A filament eruption occurred in the northeast of the disc at 19/0918UTC and looked like it could give a CME heading towards Earth. However, there is no sign of this CME in coronagraph imagery so it seems likely that the majority of it has been re-absorbed. Otherwise, no obviously Earth directed CMEs have been seen in imagery, although given the number of recent CMEs there is some uncertainty.

Wind speeds are currently slightly elevated due to waning effects of CH45/+, and are expected to continue to slowly decline over the next couple of days as this coronal hole rotates away. MOSWOC Enlil is currently suggesting a further enhancement from the large coronal hole CH46/- in the northern disc, although it is suggesting that Earth should already be entering this High Speed Stream (HSS). This is currently thought to be over-estimated in both strength and southern extent in Enlil, as well as too early in the timing, with 27-day persistence supporting this. No significant enhancement was observed on the previous rotation, however given the slightly more northward location of Earth, a slight increase is considered possible on this rotation but with low confidence. Wind speeds potentially returning to slightly elevated, perhaps elevated, by the end of Day 2 or into Day 3 (21-22 Jun). Any geomagnetic response is expected to be limited at this time of year.

Mainly Quiet to Unsettled geomagnetic activity is expected. There is a chance of isolated Active intervals Day 2 into Day 3, should we see any HSS enhancement from CH46.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Met Office SWPM.



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Radio Blackouts - X-Ray Flares:

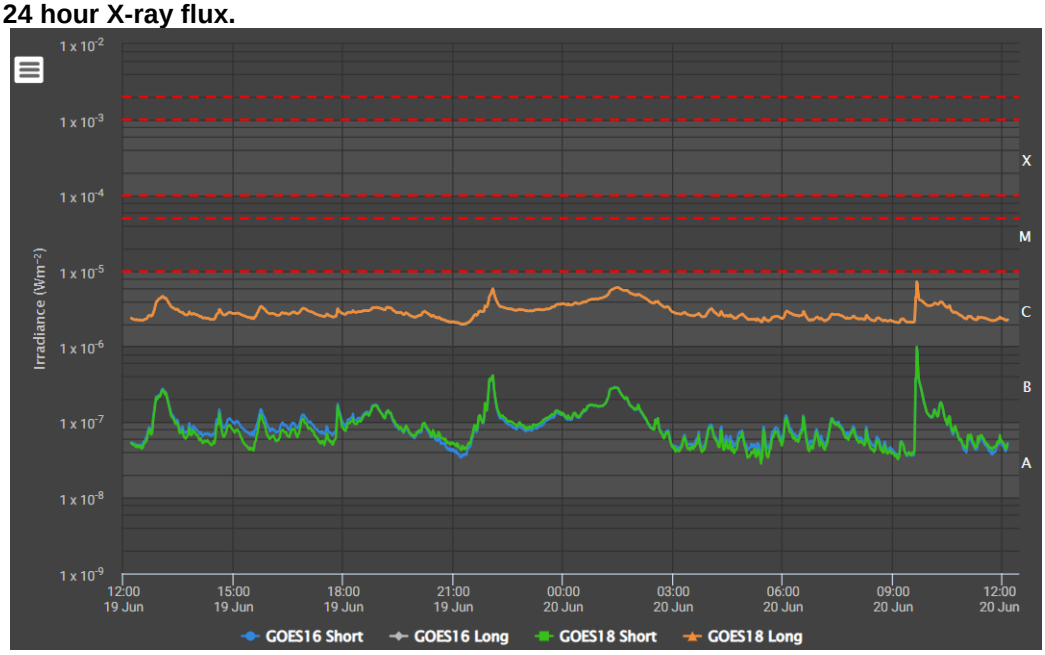
There are eight sunspot regions on the disc, with a small and simple new region appearing in the southwest. The largest region remains AR3712, continuing it's spreading trend, but without any major change in overall size, with delta regions having reformed in the trailing portion. AR3713 has continued growing, with a large delta region in one of its leading spots. AR3716 has also seen a slight growth, with a delta region remaining present in the intermediate portion. AR3719 and AR3720, close to the east limb, appear as smaller bipolar regions with the southernmost region showing a slight growing trend, now with established penumbra. The as yet unnumbered region in the northeast is simple, along with the small bipolar region, AR3718, close to centre disk.

There are a number of potential returning regions in the period, however seismic data and current imagery at the east limb do not appear to show any particularly significant regions are imminent.

Solar activity has fallen to Low, with peak flare recorded a C7.1 at 20/0939 UTC from several regions. M-class flares are considered likely, with a slight chance of isolated X-class flares, should any of the three western-most spots, AR3712, AR3713 or AR3716, produce significant flares in coming days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: 24 hour X-ray flux.



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Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux remains at background levels, with no solar radiation storms occurring. However any significant flares, from any of the three larger regions in the western disc, have the potential to increase the observed flux at GOES. This brings a chance of reaching the S1 Minor Storm threshold, with a non-zero chance of reaching S3 briefly, though this risk decreasing late in the period as one or more regions rotate around the western limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	30	30	30	20
Very Active	**≥ S3 ***	No	5	5	5	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, reached moderate levels at the diurnal maximum on 19 June as a consequence of the current fast wind enhancement from CH45/+. Electron flux is likely to continue peaking at moderate levels over the next couple of days, before the potential onset of the HSS from CH46/-, which could suppress electron flux once again. The British Antarctic Survey radiation belt model suggests that any flux increase due to CH45 has been minor, which seems reasonable given the lack of geomagnetic response to CH45, with flux levels likely to remain at background to moderate levels.

The associated electron fluence is expected to persist below the Active threshold (1e8 integrated pfu), perhaps rising a little in response to the recent enhancement. MOSWOC REFM is suggesting a rise below the Active level, which is currently considered to be good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	5	5	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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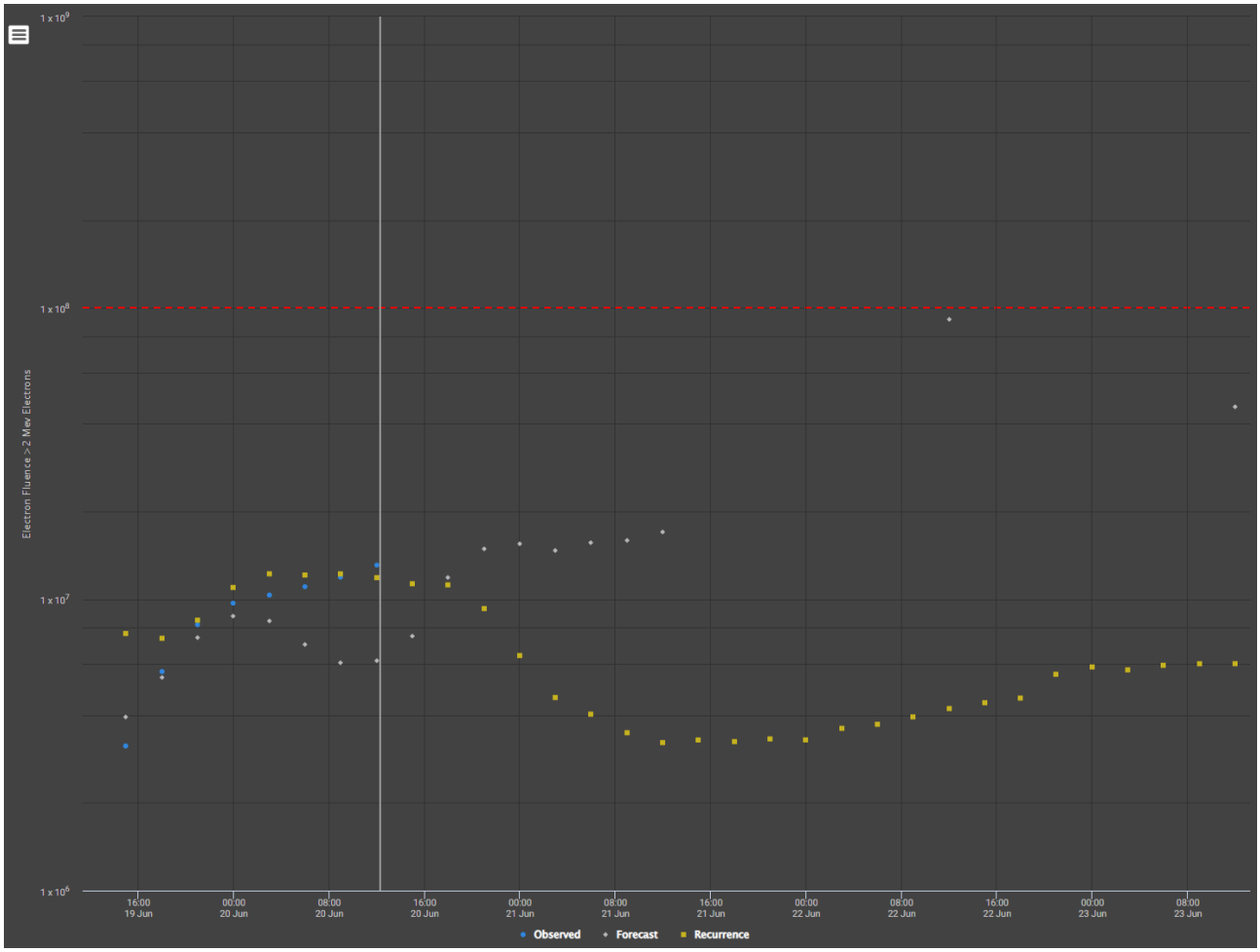
Figure 5: Met Office REFM fluence observations/recurrence/forecast.



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